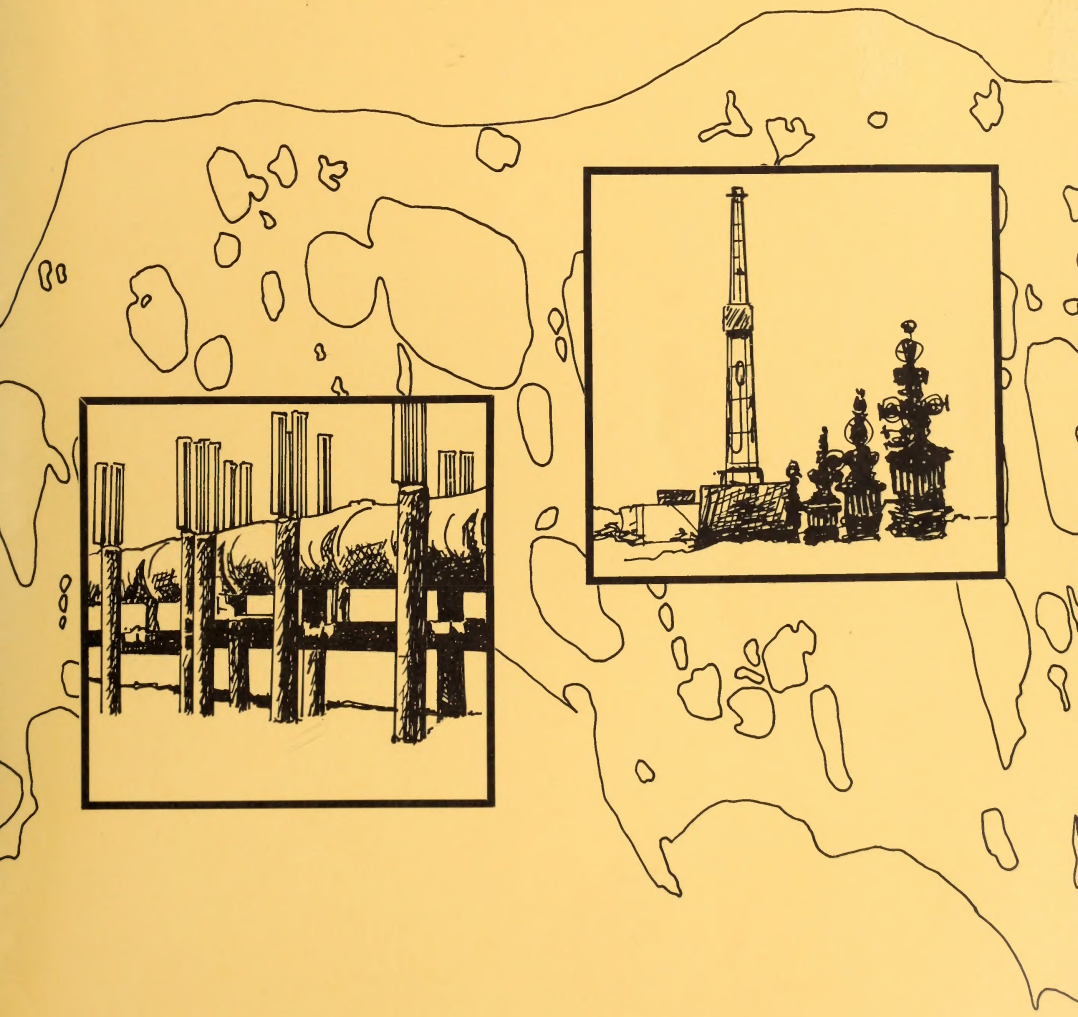
BLM-AK-PT-85-019-1620-015

Teshekpuk Lake Special Area Study

Mineral Evaluation



Bureau of Land Management, September 1, 1985

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MINERAL EVALUATION
(PUBLIC)
For

Teshekpuk Lake Special Area Study

Jack Mellor, Project Manager

FINAL

Compiled and Edited by

Michael Menge

September 1, 1985

PREPARED BY

BUREAU OF LAND MANGEMENT
ANCHORAGE DISTRICT OFFICE
ANCHORAGE, ALASKA

Wayne A. Boden

DISTRICT MANAGER

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PREFACE

This document is the public counterpart to a confidential report being used by the Bureau of Land Management's State Director in the Teshekpuk decision making process. From its inception, the Mineral Evaluation was designed to achieve the highest level of specificity possible. This was done to ensure that the decisions being made were based on the latest and very best mineral information available. To achieve this goal, it was necessary to incorporate existing company data into the evaluation framework. The only negative result of this action came from the fact that the use of company confidential data dictated the need for two separate documents. The two document approach was necessary because the Bureau of Land Management is strictly prohibited by law from divulging to the public any company confidential data or any specific information derived from such data.

With the exception of the confidential data and its derivatives, this document contains all the same information included in the decision making document.

For the reader who is interested in knowing more about the non-confidential details and procedures used to derive the information contained within this report, a detailed list of references is provided in Appendix I.

EXECUTIVE SUMMARY

The Mineral Evaluation (ME) was prepared by the Anchorage District Office, Branch of Resource Evaluation. This ME provides maps and analyses of potential mineral values for comparison with habitat values identified in a separate evaluation. The combination and weighing of these analyses will enable the best possible decisions to be made concerning the management of all values within the Teshekpuk Lake Special Area (TLSA).

The potential for energy associated impacts within TLSA could be brought about by either of two possible events. The first of these potential impacts would come about as a result of discovery and subsequent development of oil and gas prospects within TLSA. Another set of impacts would be generated by the discovery and development of petroleum resources offshore from TLSA.

The first thing considered is the possibility of development stemming from TLSA's own oil and gas potential. As a result of geologic and geophysical studies, a number of potential petroleum accumulations were identified. Based on the location of these accumulations, TLSA was divided into three zones (figure 4). Zone 1 has the highest potential, zone 2 has a moderate potential, and zone 3 has the lowest potential.

Assuming, for the moment, that all of the identified prospects within each zone exist and contain oil, zone 1 would contain 80 percent of the area's potential resources, zone 2 would contain 16 percent, and zone 3 would contain four percent. This would equate to 934.4 million barrels of potentially recoverable resources for zone 1, 192.0 million for zone 2, and 0 for zone 3.

TLSA has both oil and gas resource potential. For the purposes of this report, gas was assumed to have no current value. This is based on three facts: One, there is no current or planned market for North Slope gas; two, there is a current excess supply of domestic natural gas; and three, imported gas is relatively inexpensive at this time.

The numbers represented thus far assume that every prospect identified exists as described by the geologists and geophysicists. Since all the analyses are based on indirect measurements of very imperfect data, it is not reasonable to expect predictions to be 100 percent accurate. All of the uncertainty generated in this process is handled through the prospect risk analysis. This risk analysis, when applied to TLSA, indicates that it is a very high risk area, having only one prospect with a discovery probability greater than six percent.

Production of oil and gas would generate surface impacts within TLSA. Those impacts would result from the building and use of roads, drill pads, airstrips, pipelines, etc. In order to produce all the potential resources identified, it is estimated that you would have to disturb 4,115 acres in zone 1, 1,050 acres in zone 2, and 0 acres in zone 3.

The economic analysis of TLSA's petroleum production potential indicates that at this time, there are no prospects that would be developed. This is based on the current economic situation and the high geologic risk associated with the area. How long these prospects would remain uneconomic depends on world oil prices and the proximity of production pipelines.

As stated earlier, pressure to develop TLSA is not totally dictated by its own oil potential. TLSA can also be impacted by surrounding activities. Based on current North Slope lease holdings, the likely place for this first pressure to be generated is offshore of TLSA.

These impacts would be generated by the building and operation of onshore support bases for offshore drilling operations. In addition to these support facilities, a significant discovery offshore would generate the need for a pipeline to carry products out of the area. Technologically, an offshore pipeline is not possible at this time. An onshore pipeline in TLSA to carry products out of the area could follow one of two routes. The most economic route would be north and east of Teshekpuk Lake. An alternative route would be west and south of the lake; however, this route would be much more expensive. If severe routing restrictions are placed on pipeline routing, they have the potential for making large areas of land offshore of TLSA uneconomic to develop.

Leasing and development pressure on any area is ultimately controlled by the national demand for oil. Presently, that national demand exceeds production. The gap between the two is expected to widen in the future. This will generate an increasing demand for domestic opportunities in the future. TLSA will feel this pressure in the future. Presently, however, due to low oil prices and a world glut, there will be little leasing pressure placed on TLSA.

To get a better picture of when this pressure might be brought to bear, consideration must be given to the North Slope energy picture as a whole. Since its discovery, Prudhoe Bay has dominated oil and gas activity on the North Slope. Its resources drove construction of the Trans-Alaska Pipeline and still dominates the area's production. All of this activity has served to attract a great deal of corporate exploration to the North Slope. All of that interest and activity has resulted in a number of additional discoveries in

the area. Development has now begun to move outward from Prudhoe Bay. Pipeline construction has been extended westward into the Kuparuk field. Whether or not this westward trend continues will depend on the production potential of the discoveries that have already been made in that direction.

What can be said with some degree of certainty is that TLSA will be one of the first areas in NPRA to feel significant development pressure.

Development brings with it impacts. Impacts can be mitigated, but not removed. Mitigation can be very costly to people attempting to develop petroleum resources. If mitigative measures are too stringent, the will make development economically impossible. The economic ramifications of mitigation must be considered at the same time that the protective measures are being developed.

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CHAPTER 1

PURPOSE FOR ACTION

I. INTRODUCTION

This Mineral Evaluation (ME) is being prepared for Phase I of the Teshekpuk Lake Special Area Study to update and illustrate mineral resource values. The Teshekpuk Lake Special Area Study is being developed for an area designated by the Secretary of the Interior in 1977 as the Teshekpuk Lake Special Area (TLSA) (figures 1 and 2). This is the first Special Area Study within the National Petroleum Reserve in Alaska (NPRA). It is an effort to map, analyze, and weigh specific surface resource values against potential subsurface values. This will allow the best possible decisions for management of all values within the TLSA consistent with Congressional intent mandated in Public Law 94-258, Naval Petroleum Reserves Production Act, and PL 96-514, Department of the Interior Appropriation Act. There will be three phases involved within the Teshekpuk Lake Special Area Study.

Phase I will concurrently produce a Habitat Evaluation and a Minerals Evaluation by August 15, 1985. These evaluations will update and illustrate surface and subsurface values geographically and will propose mitigative measures, all of which will be analyzed in Phase 2.

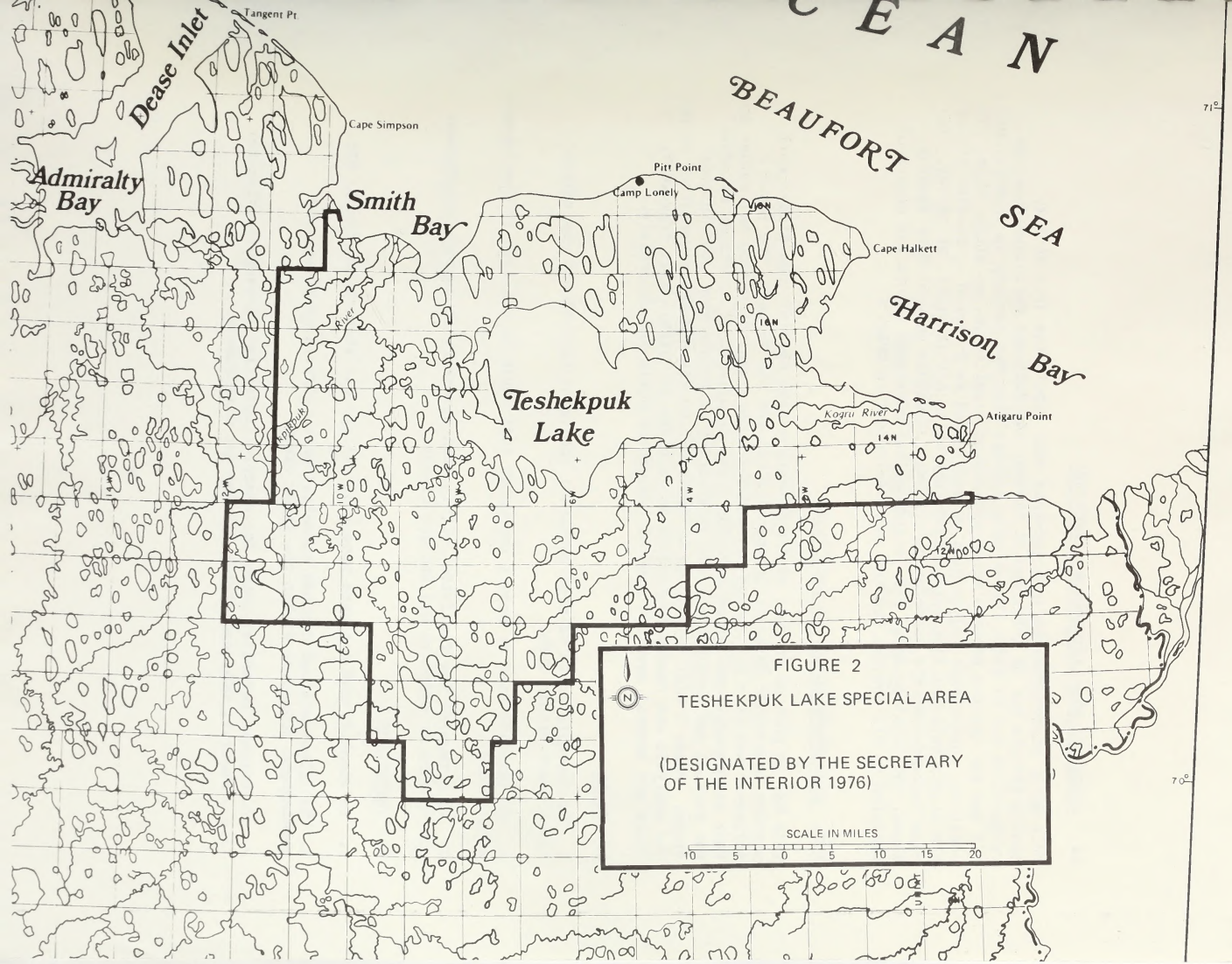
Phase 2 will analyze the biological values in relation to potential oil and gas values. After weighing these values, the District Manager will make geographic recommendations or alternatives for areas to be protected from development activities, and for areas to be offered for lease, along with the appropriate stipulations for those areas.

Phase 3 will result in final decisions by the BLM State Director, in consultation with other agency representatives, that identifies areas available for leasing by October 31, 1985. The State Director will also select a framework of mitigative measures which may be applied to any action or activities which would adversely affect important or crucial biological or subsistence values within TLSA.

Phase 4, which will be completed by February 1986, will develop a Habitat Management Plan (HMP) outlining the decisions from Phase 3.

The Teshekpuk Lake Special Area is presently managed in accordance with the Record of Decision for the Environmental Impact Statement on oil and gas leasing in NPRA.

Figure 1. Base map of Alaska, showing NPRA and TLSA. (after Bruynzeel, et al., 1982)


Dease Inlet
Tangent Pt
Cape Simpson
Admiralty Bay
Smith Bay
Pitt Point
Camp Lonely
Cape Halkett
BEAUFORT SEA
Harrison Bay
Teshekpuk Lake
Kogru River
Atigaru Point
15N
14N
13N
12N
11N
10W
9W
8W
7W
6W
5W
4W
3W
71°
70°
FIGURE 2
TESHEKPUK LAKE SPECIAL AREA
(DESIGNATED BY THE SECRETARY OF THE INTERIOR 1976)
SCALE IN MILES
10 5 0 5 10 15 20

II. AUTHORITY AND LEGISLATIVE DIRECTIVES

This ME is being prepared in accordance with Public Law (PL) 96-514, appropriations Act of 1981, and PL 94-258, the National Petroleum Reserves Productions Act of 1976. These acts mandate that BLM develop an expeditious oil and gas leasing program while protecting wildlife values within NPRA. In addition, subsistence values will be considered as directed by Section 810 of the Alaska National Interest Lands Conservation Act (ANILCA), PL 96-487. It also incorporates the cooperative analysis of values completed by Federal, State, and local agencies and considerations addressed within the Record of Decision on Oil and Gas Leasing and Development in NPRA.

III. MANAGEMENT GOALS AND OBJECTIVES

This ME, as part of Phase 1 of the Teshekpuk Lake Special Area Study, will provide geographic data for prospective oil and gas values. The Phase 2 follow-up analysis will weigh oil and gas values against biological values so that recommendations can be made for lease stipulations, locations of areas for leasing and development, and determining resources that need further study. Phase 3 will be made up of decisions by the BLM State Director, as per the analysis and recommendations made in Phase 2. Within this framework, there are several specific Mineral Evaluation goals and objectives.

A. Goals

1. To identify areas of high potential and value for oil and gas related development within TLSA.

2. To identify sand or gravel resources that could be utilized in development within TLSA.

3. To determine the facilities within TLSA necessary to support development for onshore or offshore oil and gas fields.

B. Objectives

1. To identify and evaluate potential oil and gas structures, traps, etc.

2. To illustrate and discuss potential onshore field placement and development scenarios within the study area.

3. To discuss potential needs for onshore facilities to support offshore (i.e., Federal, OCS, and State) oil and gas development.

4. To identify availability and discuss the use of sand and gravel.

5. To discuss means to minimize production impacts within TLSA by utilizing the most up-to-date and innovative techniques available.

6. To review and discuss recent energy development in the Teshekpuk area and what impacts that might generate.

7. To discuss demand analysis and orderly progressive westward development from reserves that have been or will be developed.

IV. PRESENT MANAGEMENT

The Teshekpuk Lake Special Area Study provides for a continuing effort to best manage resource values within NPRA utilizing past legislative direction coupled with a series of Environmental Impact Statement decisions and study findings.

The National Petroleum Reserve in Alaska was withdrawn as the Naval Petroleum Reserve Number 4 (PET-4) in 1923. PET-4 was under the jurisdiction of the U.S. Navy from 1923 until 1976, when management was transferred to the Secretary of the Interior and its name was changed to the National Petroleum Reserve in Alaska. The U.S. Geological Survey (USGS) was assigned exploration responsibilities, while the BLM was given management responsibility for the surface values. In 1977, during the 105(c) multiple resource evaluation studies (mandated by PL 94-258), the Secretary of the Interior designated three Special Areas within NPRA due to their significant subsistence, recreational, and fish and wildlife values. These special areas were the Teshekpuk Lake, Utukok Uplands, and the Colville River. In 1983 the BLM completed an Environmental Impact Statement on Oil and Gas Leasing in the National Petroleum Reserve in Alaska. The ROD for the Environmental Impact Statement further described these special areas by identifying zones within each area for the specific protection of significant subsistence and fish and wildlife values.

The ROD established two management areas (figure 3) within TLSA. The first designation of the ROD deleted approximately 217,000 acres in an area northeast of Teshekpuk Lake from the oil and gas leasing program until at least one of the following conditions is met in the future:

- Studies show the area is no longer critical to the life cycles of caribou and black brant;

- Analogous situations demonstrate a high degree of compatibility of calving caribou and molting black brant with oil and gas activities; or

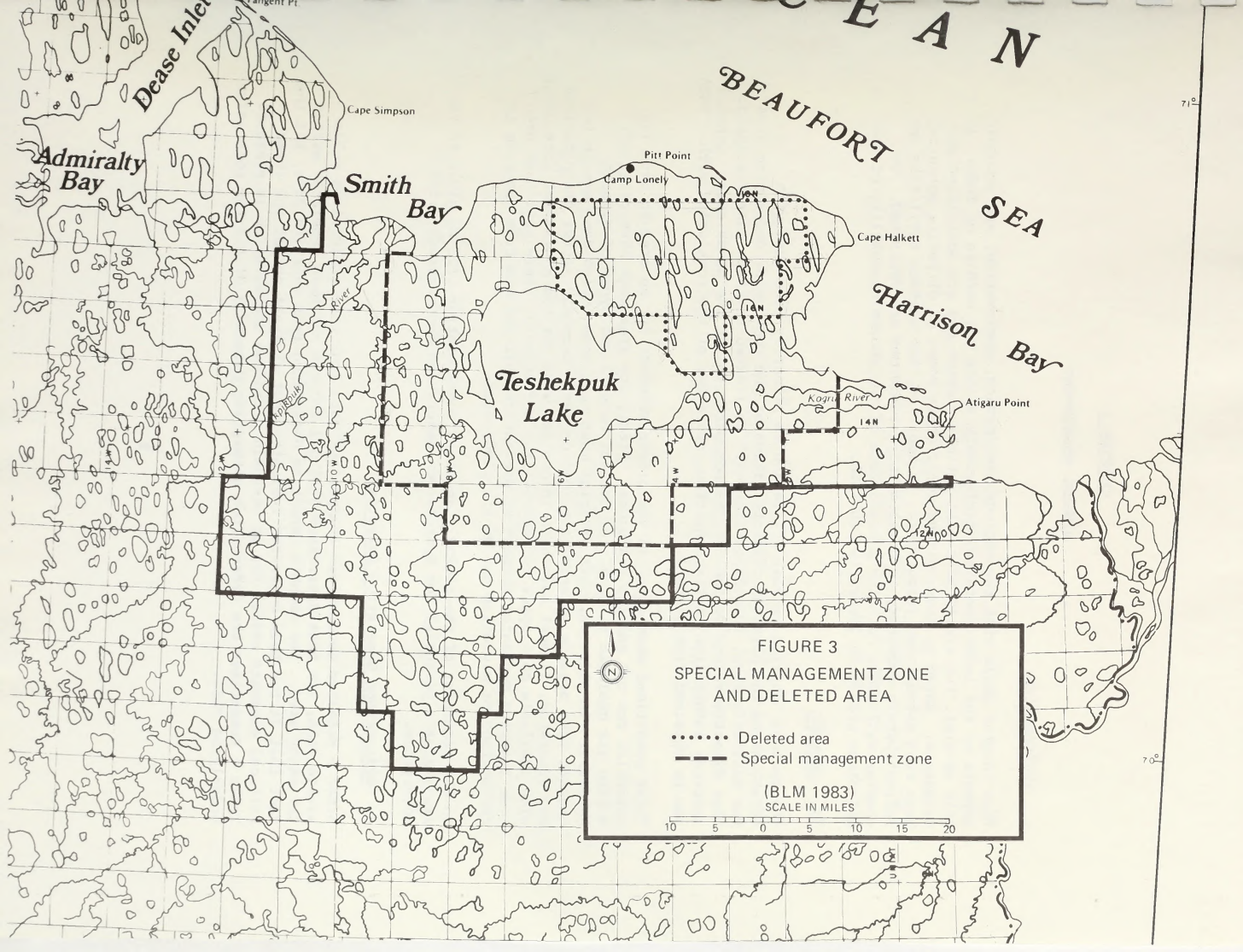
- New resource estimates and Department of the Interior directives establish that potential oil and gas values outweigh potential environmental losses.

The second ROD designation established a 750,000-acre Special Management Zone including the Beaufort Sea coastline, down to and surrounding Teshekpuk Lake (figure 3). In order to protect crucial surface resource values, a special Design Solution stipulation (see Appendix II of the Habitat Evaluation) was developed for the Special Management Zone which allows oil and gas activities to occur only after sufficient study of cumulative impacts has determined that the proposed activity would not significantly impact the resource values that have been identified. Recommendations developed in Phase 2 may modify this zone through analysis of the habitat values described in the HE.

V. BLM DECISION PROCESS

This Mineral Evaluation and the independent Habitat Evaluation will provide specific, up-to-date analysis of mineral and biological values within this area of known high biological values and potentially high oil and gas values. The analysis of this data in Phase 2 will enable the best possible leasing or permitting decisions to be made within TLSA. The geographic prioritization of specific biological and mineral values identified will continue to be used for management decisions beyond the initial leasing decision.

The BLM, in cooperation with other agencies, groups, and individuals, is attempting to evaluate both the mineral and wildlife resource values within TLSA at the highest level of specificity available to BLM to date.


Dease Inlet
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Camp Lonely
Cape Halkett
BEAUFORT SEA
Harrison Bay
Teshekpuk Lake
Atigaru Point
14N
13N
12N
FIGURE 3
SPECIAL MANAGEMENT ZONE
AND DELETED AREA
Deleted area
Special management zone
(BLM 1983)
SCALE IN MILES
10 5 0 5 10 15 20

CHAPTER 2

MINERAL ASSESSMENT

I. INTRODUCTION

This chapter deals with the geology, geophysics, engineering, and economic aspects of the lands contained exclusively within the borders of TLSA. In this section, the area's potential petroleum resources are identified and discussed. Based on these discussions, three zones of differing potential have been established (figure 4). In addition, the surface facilities and infrastructure necessary to develop those resources are described. The chapter will close out with a discussion of the economic viability of the petroleum prospects identified in TLSA.

II. GEOLOGY

The geologic portion of this evaluation is primarily concerned with establishing the physical characteristics of the rock units underlying TLSA. For brevity's sake, this discussion will be limited to those characteristics that directly relate to the hydrocarbon potential of the study area. General interest information on the subsurface character of the rock units within TLSA can be obtained from plate 1.

Three conditions must occur in the proper sequence for an area to have any potential for oil and gas resources. First, the area must have received, during its geologic history, the correct amounts and types of organic material. In addition, this material must have been buried deep enough to convert that organic material into oil or gas. Secondly, after the petroleum was generated, it must have been in contact with (or had access to) rock units with available pore space to receive it. And thirdly, there must have been some trapping mechanism present to prevent the oil and gas from escaping to the surface or migrating out of the study area.

In the remainder of the geologic section, consideration will be given to the study area's potential for hydrocarbon generation and reservoir rock occurrence.

A. Hydrocarbon Generation Potential

After a detailed geochemical analysis of data from five exploration wells within TLSA, its been determined that oil and gas has been generated within the study area. The amounts cannot be determined from existing data, but the fact that it has been generated indicates that at least one of the three critical elements needed for an economic petroleum accumulation is present. Table 1 summarizes the hydrocarbon generation potential of all the rock units underlying TLSA.

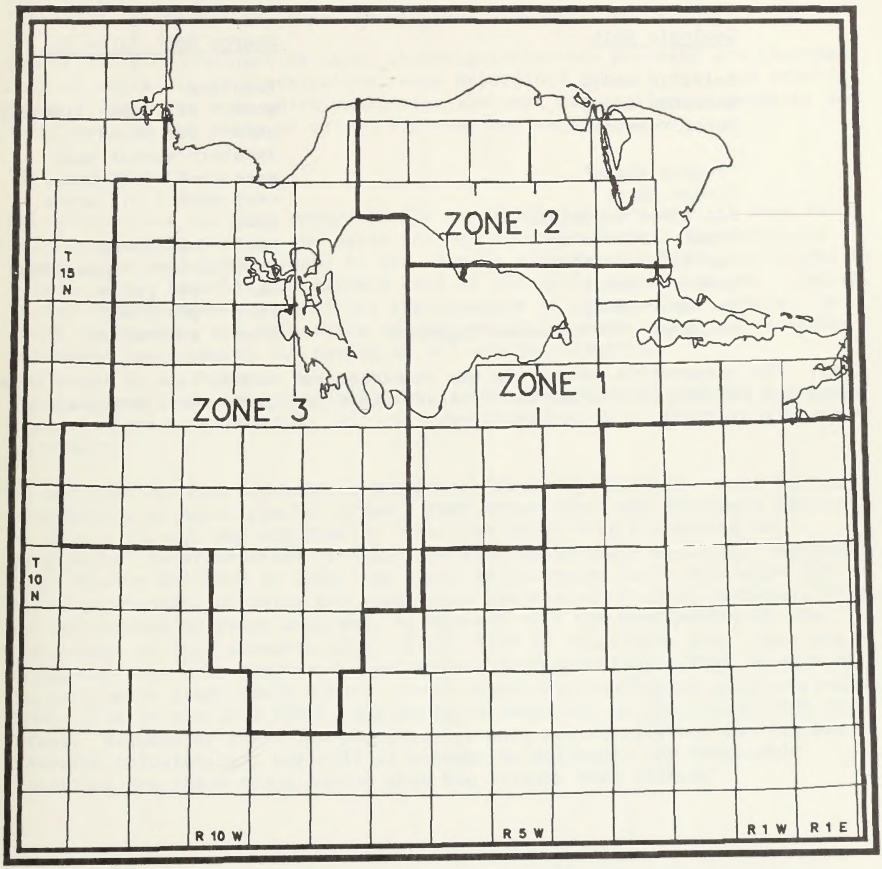

Figure 4. Zones of oil and gas potential.

TABLE 1

Source Rock Potential

Geologic Unit	Source Rock Potential
Colville Group	immature
Nanushuk Group	good - oil prone (immature)
Torok Formation	good - gas prone - immature except base
"Pebble shale"	excellent - oil prone
Kingak Shale	very good - oil prone
Sag River Sandstone	good
Shublik Formation	good - oil prone
Sadlerochit Group	poor to fair - gas prone
Lisburne Group	fair - oil prone
Endicott Group	fair - gas prone
Basement - Franklinian Sequence	none - overmature

NOTE: For information concerning the thickness and composition of these rock units and how they fit together in relationship to one another, see plate 1.

B. Reservoir Rock Potential

There are many geologic characteristics that in combination define a rock unit's reservoir potential. Some of the most important of these are lithology, permeability, water saturation, thickness, and porosity.

Two of the most dominant of these characteristics are porosity and thickness. Both of these, in this evaluation, were determined through well log studies. Table 2 lists the rock units exhibiting the best combination of porosity and thickness and the range of values recorded for each.

III. Geophysics

The geophysical analysis completed for the Teshekpuk Lake Special Area Study utilized seismic data as the basis for its determinations. This analysis provided two major components to the overall assessment. First, it helped to delineate the location and maximum size of the study area prospects. Second, it contributed toward determining the presence of trapping mechanisms. As noted previously, the occurrence of these trapping mechanisms is one of the necessary requirements for having an oil and gas reservoir.

The geophysical analysis in TLSA identified and delineated several potential accumulations or prospects. All of these prospects were primarily structural in nature.

In addition to those structural prospects identified in TLSA, there is the possibility of stratigraphic traps. Such occurrences are extremely difficult to detect through any exploration technique other than a coupling of geophysical interpretation with high density exploratory drilling. Lacking high density drilling in TLSA, the study to determine their existence was based on regional porosity and subsurface geophysical mapping analyses. Based on the results of these analyses, it appears that the probability of the occurrence of stratigraphic traps within TLSA is relatively low. They are mentioned here only because the subsurface configuration of TLSA is such that stratigraphic traps could occur. These compatible conditions exist throughout TLSA, with no one area having any better probability of occurrence than any other. Because of their low probability, this report will not contain any resource calculations, nor will it attempt to delineate any geographic locations for these traps beyond what has already been stated.

TABLE 2

Reservoir Rock Characteristics
(Porosity and Thickness)

Geologic Rock Unit	Porosity Range (percent)	Reservoir Thickness Range (feet)
Torok/Pebble Shale	9.0 - 13.0	40-80
Pebble Shale	10.5 - 14.6	10-40
Kingak Shale	6.0 - 12.0	40-80
Sag River	7.8 - 19.8	50-100

Establishing the presence of trapping mechanisms was extremely difficult with the data available for this evaluation. A combination study of geologic and geophysical data suggests the likelihood of their presence, but since they remain unproven, their existence was dealt with through probability.

All of the preceding discussions are based on the assumption that the subsurface picture put together by the geologists and geophysicists is 100 percent accurate. Also to this point, it was assumed all of the prospects contained oil. Since all of these analyses are based on indirect measurements of very imperfect data, it is not reasonable to expect predictions to be 100 percent accurate. This situation is even further complicated by the fact that the evaluation team had to look back in time tens of millions of years and reconstruct the area's complex geologic history one step at a time back up until the present. All of these varying degrees of uncertainty must be quantified and standardized in such a way as to enter them into the evaluation process. This is done through risk analysis.

The risk analysis completed for TLSA simultaneously evaluated the quantity and quality of data used and measured that against the area's geologic complexity. The risk numbers created out of this analysis are referred to as probabilities of success. Only one prospect in TLSA had a probability of success greater than six percent. It is important to remember that until a prospect is drilled, its resource potential remains unknown; and that the risking process is based on professional judgments of existing information. As such, new data has the potential for dramatically altering the professional's perception of an area's resource potential. This is particularly true in a frontier area like TLSA where quality data is relatively scarce.

IV. ENGINEERING

The engineering section of this evaluation provides two major types of information. First, it drew from the geologic and geophysical data sets the information necessary to determine the kind and amount of development facilities necessary to produce petroleum from the subsurface. Second, the engineering study provided the amount of recoverable petroleum that could be expected to be produced from the identified prospects. Both of these elements were critical to the overall mineral assessment.

A. Facilities

The facilities necessary to explore for, develop, and produce oil and gas would generate most of the impacts on TLSA. For this reason, it is important to know what those facilities are. Based on potential impacts, facilities are divided into two groups. Group one deals with exploration, and group two looks at development and production.

1. Exploration Facilities

Facilities needed for petroleum exploration generally include a temporary drill pad, an airstrip, and a connecting road. Exploration activities would generally take place during the winter season. This being the case, all of the facilities would be constructed on an ice base. If done properly, ice-based construction should have little long-term lasting effect on the surrounding environment. It is most likely that any future exploration activities in TLSA requiring a drill pad, airstrip, or road would take place during the winter months.

2. Development and Production Facilities

Development and production facilities are divided into six major categories. These are listed in table 3, along with the acreage required for each and the cubic yards of sand or gravel required to build them. The surface disturbance associated with the development of oil and gas prospects are composed of a mix of those facilities. Their number and size will be controlled by the size, depth, and location of the prospect. Since the specific location of the oil and gas prospects is confidential, figure 5 is provided as an example to illustrate the number and location of facilities necessary to develop what would be considered a typical prospect.

The number and location of facilities identified in this assessment are based on the assumption that the prospects are filled to the capacities calculated during the evaluation process. Additionally, it is assumed that the facilities would be constructed at the most technically efficient location from a mineral development point of view.

One additional type of facility will, in all likelihood, need to accompany onshore development. Any discovery large enough to warrant development will require a barge landing/dock complex. The exact location of that facility would depend on where the discovery was made. If geographically feasible, additional discoveries would share a single barge landing/dock complex.

All of this information, when specifically applied to TLSA, helps to establish the approximate magnitude of disturbance that would be associated with production of the area's potential resources. Table 4 is a summary of what facilities would be required to develop all the potential prospects in each zone and the amount of acreage disturbance associated with that development. Readers are reminded that the numbers shown in table 4 assume that all of the prospects identified within each zone will be developed. The probability of this happening is extremely low. This being the case, numbers shown for each zone should be considered good approximations of maximum disturbances that could occur.

TABLE 3

Production Facilities with Associated
Disturbance and Bulk Material Requirements

Facility	Acres Disturbed (each)	Cubic yards of material to Construct (each)
Central production facility No. 1	90	300,000
Central production facility No. 2	40	132,000
Drilling pad (depends on number of holes drilled from the pad)	23 (average)	75,000
Airstrip and associated support	30	125,000
Roads	5 acres/mile	20,000 yds^3/mile
Pipelines	5 acres/mile	20,000 yds^3/mile

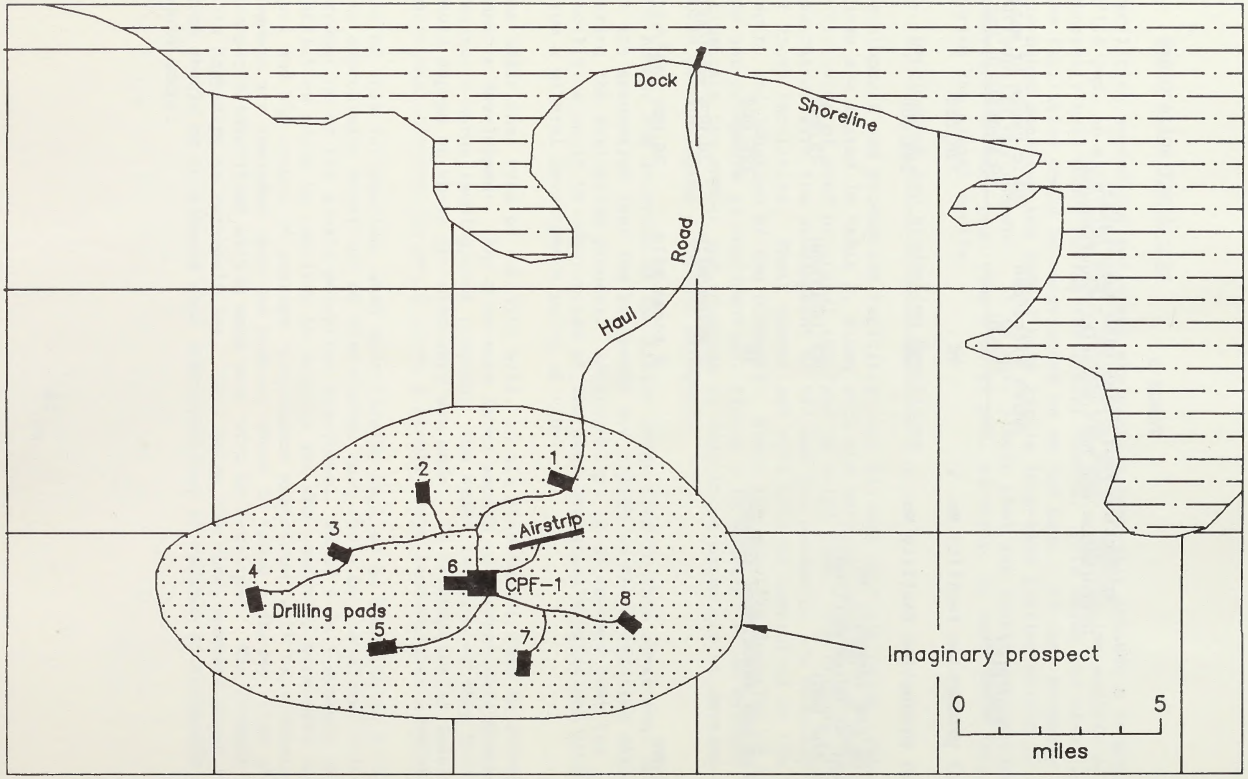

Figure 5. Typical development scenario.

It is technically possible to adjust placement of facilities if it becomes necessary. The flexibility of movement depends on the type of facility being discussed and, to some extent, the depth of the prospect. Roads, airstrips, and pipelines have the maximum flexibility; central production facilities represent a middle ground in ease of movement, and drill pads are the least flexible. The depth of the horizon being produced controls the location of drill pads. Because of the depth of the prospects in TLSA, options are limited, allowing no more than 1,000 feet in any direction.

One of the prime factors in any consideration of oil and gas production from the North Slope is the availability of sand and gravel. As we have illustrated, all the facilities associated with petroleum production consume large amounts of these bulk materials (table 3). In the past, gravel has been the primary material used for North Slope development projects.

As illustrated in plate 2, TLSA contains a very limited amount of known gravel resources. What is available is restricted to the coastal areas around Camp Lonely and the northwestern shore of Lake Teshekpuk. Considering the limited volume and location of these known deposits, it is unlikely that they would be used for anything except local maintenance of existing facilities (i.e., Camp Lonely). This being the case, the next closest known source of gravel is the Colville River, lying more than 60 miles east of the closest delineated TLSA prospect. Therefore, it is assumed, for the remainder of this evaluation, that hauling gravel into the study area is not an economically viable alternative. Should a road be constructed at some point in the future west out of Kuparuk through TLSA, the economics of gravel hauling would improve. Even with an existing road, the economics of hauling gravel that far would still most likely prove to be uneconomic.

What TLSA lacks in gravel, it makes up for in sand. The entire southern half of the study area (plate 2) is underlain by abundant sand resources. Use of sand would require the development of an alternative construction method other than that now being used. Such a system, using a plastic roadbase confinement grid, has been developed and tested in the lower 48. Although use of the grid has not been tested under arctic conditions, sand is a non-frost-susceptible material; therefore, the grid is expected to perform similarly to installations in warmer climates.

There is some risk associated with assuming that a new construction method is economically feasible for use in the arctic; but, based on the lengthy analysis that has been done on this subject, it is felt that there is a better than even chance of its being successful.

TABLE 4

Production Facilities with Associated Disturbance
and Bulk Material Requirements by Zone*

	Zone 1			Zone 2			Zone 3
Infrastructure	Number	Acres Disturbed	Sand/Gravel Requirements	Number	Acres Disturbed	Sand/Gravel Requirements	Number
Drilling Pads and Central Production Facilities	60	1,575	5,510,000 yd^3	12	410	1,350,000 yd^3	0
Barge Landing/ Dock and Associated Storage Area	1	10	150,000 yd^3	0	0	0	0
Airstrips and Associated Facilities	3	90	375,000 yd^3	2	60	250,000 yd^3	0
Miles of Road and Pipeline	244	2,440	9,720,000	116	580	2,320,000 yd^3	0

*Facilities, disturbance, and bulk material requirements shown here by zone are cumulative numbers for all of the prospects contained within each zone.

B. Petroleum Resources

Having established the amount and type of facilities and material necessary to develop the prospects, the next consideration of importance is how much oil and gas can be produced from each. A large variety of inputs are necessary to calculate petroleum resources. An example of these inputs, along with a description of the major components, is contained in Appendix IV. There are three end-products of importance that result from this analysis; the in-place resources, the recoverable resources, and the risked recoverable resources.

In-place resources refers to the amount of oil and gas present in the prospect. With this as a base number, calculations can be made to determine what is technically possible to produce to the surface. This is called the recoverable resource. This derivative number is dominated by recovery efficiency. For the purpose of this study, a recovery efficiency of 30 percent was used for each prospect. This number is based on studies of the Kuparuk field, which is believed to be a good analog of the prospects in TLSA. It is possible that in the future, utilizing enhanced recovery methods, the recovery efficiency will rise above 30 percent. Ultimately, the use of enhanced recovery techniques is controlled by the price being received for the oil produced. If the price of oil increases significantly, the use of enhanced recovery techniques could increase and, thus, the recovery efficiency would improve. Risked recoverable resources provides the evaluationist with a method to combine uncertainty (risk) with the calculated resources for an area. This number is useful when comparing the size and risk of one prospect or area with that of other prospects or areas. Table 5 contains the recoverable and risked recoverable resources calculated for each of the three zones in the study area. The resource numbers shown in this table represent cumulative totals for all of the identified prospects in each of the particular zones.

For the purposes of this mineral assessment, natural gas was considered to have an extremely low current value. This assumption is based on the fact that there is no current market for North Slope gas. This, coupled with the current excess supply of domestic natural gas and the relatively low cost of imported gas, results in considerable uncertainty as to the future development of North Slope gas reserves. Based on this analysis, natural gas has been dropped from any further consideration in this study.

V. Economics

The economic analysis section of any assessment provides the bottom line data everyone is interested in. Based on current economic conditions, it determines if there are any potentially viable prospects in the area being

evaluated. To answer this question, the economic analysis takes into consideration a tremendous number of variables. A generalized list of these variables is shown in table 6. Each variable plays an intricate role in the economic evaluation process. The output from this assessment (used in the Teshekpuk Lake Special Area Study) consists of a screen called the minimum economic field size.

TABLE 5

Estimated Resources

Zone Number	Recoverable Resources* MMSTB	Risked Recoverable* Resources
1	934.4	39.9
2	192.0	3.7
3	0.0	0.0

MMSTB = million stock tank barrels.

*Recoverable resources and risked recoverable resource numbers shown here by zones are cumulative numbers of all the prospects contained within each zone.

Minimum economic field size (MEFS) is defined as the smallest volume of hydrocarbon reserves which will pay the cost of extracting and marketing the resource under expected future economic conditions and provide the investor with a rate of return on capital that is equal to the rate that is expected from projects of similar risk.

The following is a brief discussion on how the MEFS was established for the Teshekpuk study. The first step taken was to create a hypothetical prospect by averaging together the reservoir characteristics from all of the area's identified prospects. Next, economic input values necessary to evaluate that prospect were generated by averaging together ranges of economic projections. Hypothetical prospect resource numbers were then analyzed in conjunction with the economic input values. The results of this procedure indicated that the prospect did not contain enough recoverable resources to make it economically developable under present conditions. The analysis process was repeated several times, gradually increasing the hypothetical prospect reservoir parameters (size, thickness, etc.) unit a recoverable volume of oil was defined sufficiently large enough to make the prospect economically viable. This hypothetical prospect then became the standard, or MEFS, against which all of the area's real prospects were measured. To make it a realistic standard, the maximum size that the hypothetical prospect's characteristics were allowed to reach was controlled by what could reasonably be expected to occur within the study area.

The MEFS is usually expressed in terms of recoverable resources. In the case of TLSA, this number came to 900 million barrels of recoverable oil. When compared to this value, it is found that there are presently no identified economically viable prospects within the study area.

Based on the current interpretation, the TLSA prospect with the highest recoverable resource potential equals approximately 45 percent of the MEFS. This means that for development to take place in TLSA (under current economic conditions and geologic interpretations), several prospects would have to be discovered and developed simultaneously. Considering the overall risk of the area, the probability of multiple economic discoveries in TLSA being close enough together to develop as a single unit is less than one percent.

Readers are cautioned not to compare the MEFS values to the zone reserve estimate totals shown in table 5. The MEFS is a standard against which individual prospects are measured. Since zone numbers represent totals from a number of prospects, MEFS values are not directly applicable.

The information presented in this chapter indicates that TLSA's prospect development potential (under current economic conditions) is relatively low. It is important to remember that this interpretation is based on professional judgments made from current geologic and economic information. Until such a time as test wells are drilled into the prospects, their true potential will remain unknown. This being the case, each new piece of data received has the potential for altering the perception of the area's potential. This is particularly true in the case of frontier areas like TLSA.

TABLE 6

Parameters Considered for Determination
of Minimum Economic Field Size

Economic	Engineering	Geologic and Geophysical
Hydrocarbon markets and prices	Potential reservoir productivity	Location, depth, and presence of trapping mechanism
Oil price and cost escalation	Facilities design, layout, and cost	Presence of source rock
Transportation tariffs and escalation	Well location and cost	Presence of reservoir rock
Federal and State taxes	Transportation system design and cost	Probability of geologic success
Royalty rates	Development schedule	Potential reservoir characteristics
Discount rates	Operation capacity and cost	Potential hydrocarbon volume

CHAPTER 3

EXTERNAL OIL AND GAS ACTIVITIES AFFECTING THE TESHEKPUK AREA

I. INTRODUCTION

The preceding economic analysis completes that portion of the study that deals solely with the development potential of prospects within TLSA. Since the probability of any area's development is greatly affected by surrounding activity (this is especially true in the arctic), the scope of this study will now be expanded to take in all the petroleum activity on the North Slope. This will be done in two sections. First, offshore development directly north of TLSA is considered to see what effects that might have on the study area. Second, the total oil and gas development picture on the North Slope is looked at to see how that might impact the Teshekpuk area.

II. POTENTIAL ONSHORE IMPACTS FROM OFFSHORE DEVELOPMENT

As seen on plate 4, a significant amount of acreage offshore from TLSA is presently under lease. Exploration in that area is currently underway, but to date, no commercial discoveries have been reported.

A significant discovery offshore has the potential for triggering a series of onshore events affecting TLSA. For ease of discussion , those events are divided into two types of activities. The rest of this section considers these activities in a little more detail.

A. Onshore Support Base

The first type of activity likely to be generated by a significant offshore discovery would be the construction and subsequent operation of support base. For economic reasons, this support base would most likely be located at the present site of Camp Lonely (plate 3). This being the case, construction would consist of upgrading existing facilities. This activity would have a minimal impact on the existing environment. If the discovery is made too far east or west to be supported out of Camp Lonely, a complete support complex would have to be built. Construction impacts in this case would be considerably more significant. The facilities associated with an onshore support base are approximately the same as those for an onshore prospect, with the exception that there would be no drill pads or extensive road complexes. Operation of a large support base, no matter where it is located, would result in a dramatic increase in air traffic and human activity in the area.

B. Pipelines

The potential for occurrence of the second type of activities is somewhat more speculative, but much more significant in its potential effects on the environment. This second series involves the need for an onshore pipeline to bring offshore products to market. A pipeline designed to accomplish this task could follow one of three possible routes (plate 3). Private industry's reaction to the first draft of this section, which suggested the possibility of a total offshore pipeline route (corridor 1), was unanimously negative. Although a total offshore route would have little, if any, effect on TLSA, it does not appear to be a viable alternative at this time. This finding is based on the fact that there is no existing pipeline technology that can safely deal with the ice and permafrost conditions that are expected to be encountered offshore. If the offshore corridor is not possible at this time, that only leaves corridors 2 and 3. Corridor 2 would require any landed offshore pipeline to bend around to the west and south of Teshekpuk Lake. Corridor 3 would be the most direct route, but would pass through the most sensitive habitat areas. Both of these onshore pipeline routes are further complicated by the need for accompanying year-round service roads.

Assuming there is no significant technological difference between building a pipeline in corridor 2 and in corridor 3, the big difference becomes one of economics. For the sake of discussion, three potential landfalls have been assumed (plate 3). In reality, a pipeline would follow the shortest possible route to shore and could land almost anywhere along the coast. The differences in construction costs for corridors 2 and 3 are shown in table 7. As can be seen from this table, there is a significant cost difference between the two pipeline routes. A decision to prevent a pipeline from being constructed through corridor 3 could very well preclude any offshore development north of TLSA. Table 7 also points up the fact that the economic significance of routing decreases the further west the pipeline is landed.

Considering the increased levels of leasing and exploration activity offshore, it could very well be that the first serious development pressure brought to bear on TLSA will come from that quarter.

III. NATIONAL DEMAND AND REGIONAL PETROLEUM DEVELOPMENT

The need to offer leasing opportunities in areas like TLSA is ultimately driven by the domestic demand for petroleum products. In order to replace domestic petroleum reserves that are currently being depleted, new areas must be leased and explored, and any commercial reserves that are identified brought into production.

In order to better understand this need, it is necessary to take a quick look at the past, present,and future projected national demand and production trends.

TABLE 7

Cost Estimates for Onshore Pipeline
Through TLSA to Support Offshore Production

Location of Landfall	Estimated Cost of * Pipeline Through Corridor 2	Estimated Cost of Pipeline Through Corridor 3
Pogik Point	$504,000,000	$212,000,000
Pitt Point	468,000,000	252,000,000
Drew Point	396,000,000	288,000,000

* Costs assumed to be similar to Kuparuk River oil pipeline.

Domestic petroleum consumption peaked in 1978 at 18.85 million barrels per day (bpd) and then declined to 15.23 million bpd in 1983. Demand has once again began to increase. Production, on the other hand, has remained relatively stable near 10.3 million bpd since 1977. Almost all long-term predictions on domestic petroleum production project a downward trend. Deficits between demand and production must be made up with foreign imports. If these trends continue, the United States will continue to be increasingly dependent on foreign sources to meet future petroleum needs.

These facts clearly indicate that the demand for additional leasing and exploration opportunities will continue to increase over the long-term. Near-term demand, however, is dictated more by current world petroleum market conditions. The United States petroleum market is greatly influenced by conditions of the international petroleum market. The world petroleum market is currently plagued by excess productive capacity and declining oil prices. The over-supply conditions and resulting effects of prices has served to reduce the near-term demand for leasing and exploration opportunities.

The preceding analysis, when specifically applied to TLSA, indicates that the near-time demand for leasing opportunities will not be very great. This is further supported by the lack of activity on the lands already under lease within TLSA (plate 4). In the long-term, however, it appears that increasing exploration and development pressure may stimulate interest in the area. To determine when that pressure might occur, it is necessary to look at North Slope oil and gas activity as a whole.

As indicated, it is impossible to discuss the development potential of TLSA without considering the overall North Slope Alaskan energy picture (plate 5). To date, that overall picture can be summed up in two words: "Prudhoe Bay." Ever since its discovery in 1968, it has dominated the energy picture on the North Slope. Its resources drove the construction of the Trans-Alaskan pipeline and still continue to dominate the area's production. Its transportation and support facilities continue to serve as a nucleus for all exploration activities north of the Brooks Range.

The development and production of Prudhoe Bay, along with the construction of the Trans-Alaska Pipeline, served to draw a great deal of industry activity to the North Slope. That level of activity has resulted in a number of discoveries being made in the region. These include Kuparuk, Lisburne (underlying Prudhoe Bay), Endicott, Milne Point, Seal Island, Colville Delta, West Sak, Ugnu, Flaxman Island/Point Thompson, and Gwydyr Bay.

Development has slowly begun to move outward from Prudhoe Bay. A pipeline has been built westward to Kuparuk, and that field is now under production. Permits have been approved for the onshore portion of the Lisburne Formation; development and drilling is presently underway. Conoco Incorporated, operator of the Milne Point field (west of Prudhoe and north of Kuparuk), has begun development of its field. Sohio, AK Inc., has also announced plans to develop its Endicott field, which lies to the east of Prudhoe. Delineation wells are now being drilled in the Seal Island field to determine its commercial viability, but, as yet, no specific development plans have been announced. Texaco has made public its intentions to follow-up on their Colville Delta discovery with two delination wells.

As demonstrated in the previous paragraph, the development and production of crude oil is now beginning to move away from Prudhoe Bay. Of prime interest to people concerned with the Teshekpuk area is the direction in which that movement will proceed.

To determine that, the first thing to consider is where the oil is now being discovered. From earlier discussions and looking at plate 5, it can be seen that there have been deposits delineated both east and west of Prudhoe. So this would indicate that development could go either way. The next most important thing to consider is in which direction are the pipelines and roads being built. A key element in determining the economic viability of any oil discovery is whether or not it contains enough reserves to pay for the building of its own crude oil transportation system. Simply stated, the farther the road and pipeline have to be built to produce the prospect, the bigger the prospect has to be to support the cost. This being the case, the construction of the Kuparuk pipeline and road system west out of Prudhoe Bay would suggest that this is the direction development might proceed. However, since the Kuparuk system is only 30 miles long, the reader is cautioned not to place an undue amount of emphasis on this single point. Continued movement in that direction will depend on the size and production potential of discoveries made in that direction.

In the final analysis, TLSA proximity to existing North Slope oil and gas activities and infrastructure could cause it to be one of the first areas within NPRA to feel significant development pressure.

CHAPTER 4

SUMMARY OF OIL AND GAS DEVELOPMENT IMPACTS AND THEIR MITIGATIVE MEASURES

I. INTRODUCTION

This section deals primarily with the significant impacts associated with petroleum exploration and development, discusses measures to mitigate those impacts, and looks at economic ramifications of impact mitigation to the oil and gas industry.

II. EXPLORATION IMPACT AND MITIGATION

Activities associated with oil and gas exploration can be grouped into three categories. These are geologic field work, geophysical seismic operations, and exploratory drilling.

Seismic operations and drilling are primarily done during the winter months. With proper supervision and winter-only activity permits, it appears that both seismic and drilling operations can be accomplished with little or no impact on the surrounding environment. Summer geologic field work consists mainly of helicopter overflights and outcrop sampling programs. Stipulations that close off specific areas during prime wildlife usage should be able to effectively protect the habitat. Stipulations of this nature, if known about far enough in advance, will not have a great effect on the economic viability of a summer exploration plan.

Previous experience in arctic Alaska indicates that exploration activities described above can take place in TLSA without significantly affecting the existing environment. Winter-only stipulations do not place an unreasonable economic burden on exploratory seismic and drilling operations in TLSA. Many seismic and drilling operations have already taken place in TLSA. To date, these activities do not appear to have had a harmful effect on the area.

III. DEVELOPMENT IMPACT AND MITIGATION

Impacts result from four categories of development activities. These categories, along with their major impacts, are listed in table 8. Measures which can mitigate these impacts are also included.

Unlike exploration activities, development and production operations must go on throughout the year. Any stipulations to restrict activity to specific times of the year would, in all probability, make the whole project uneconomic. If the decision is made to allow year-round activity, then some measures can be taken to lessen the impacts.

TABLE 8

Development Activities, Impacts,
and Mitigating Measures

Activity	Impact	Mitigating Measures
Production pads and processing facilities	Increased activity Noise Habitat loss	Use multiple-well pads Selective siting
Roads and airstrips	Vehicular activity	Minimize road use or schedule use (caravans)
	Aircraft activity	Flight restrictions
	Noise	Dust abatement
	Particulate pollution	Minimize efficiency of road system
	Barrier to wildlife movement	
Living quarters	Human activity Sewage treatment Solid waste disposal	Incineration, treatment of solid and fluid wastes Backhaul unburnables
Pipelines	Oil spill Loss of habitate Barrier to wildlife movement	Monitoring and spill contingency plans Pipeline design to facilitate wildlife movement

Mitigation of impacts resulting from exploration and development can be accomplished by many methods. Implementation of the NEPA process would provide regional and site-specific analysis of impacts. Leasing and permitting processes would allow the institution of specific stipulations and conditions of approval. BLM oil and gas policies and procedures allow for regulation of operations according to Onshore Orders, Notices to Lessees, and regulations. Finally, other Federal, State, and local agencies with jurisdiction over oil and gas activities in TLSA provide interagency capability for analysis and mitigation of impacts.

New technology as it is developed has the potential for impact mitigation. Recent advances in directional drilling, for example, may in time lessen the number of drill pads necessary to produce a field. It is also possible that in time pipeline technology could advance to the point that offshore routes or all buried routes become safe and economic. Unfortunately, it is impossible to predict accurately when new technology will be available or what effect it might have on impact mitigation.

In conclusion, then, it has been shown that exploration activities can be mitigated to the point where there are no significant impacts to the environment, while still accomplishing the explorationist's goals. The impacts of development and production, on the other hand, cannot be totally mitigated. These impacts can be lessened, but not removed. Mitigative measures designed to remove those impacts are likely to prove too expensive for the project to operate profitably.

CHAPTER 5

COMMENTS ON THE DRAFT MINERAL EVALUATION

I. ORGANIZATIONS AND GOVERNMENT AGENCIES (STATE AND LOCAL) WHO COMMENTED ON THE DRAFT MINERAL EVALUATION

A. State and Local Government Agencies

1. State of Alaska
2. North Slope Borough

B. Organizations

1. Alaska Oil and Gas Association
2. ARCO Alaska Oil Company
3. Exxon Oil Company
4. Texaco Oil Company

II. GENERIC COMMENTS

The following generic comments were developed by combining the major individual comments that were received during the draft review process, and are not attributed to any specific individual or organization. A complete list of all comments received are presented in Appendix II.

A.

Comment:

A pipeline for offshore production is unlikely to run offshore to the Prudhoe Bay Kuparuk area. It is likely to run directly to shore and then easterly by the most economically and environmentally feasible routes and probably through TLSA.

Answer:

This final document agrees that an onshore pipeline is the best option available. An offshore pipeline is discussed only in the context of what might be possible with new technology.

The final draft will show that an onshore pipeline is the best option available. This finding is based on existing technology. An offshore pipeline will be discussed only in the context of what might be possible with new technology.

B.

Comment:

Distance to an offshore discovery may have no bearing on a decision to bring pipelines to shore within TLSA.

Answer:

Same response as for comment A.

C.

Comment:

They agree that Camp Lonely near Pitt Point is a likely site for exploration support facilities with the possibility for additional permanent facilities.

Answer:

This statement is in agreement with the existing document.

D.

Comment:

The Section regarding natural gas production should be reworded to indicate that natural gas production from the North Slope is likely in the future and should not be discounted for planning purposes.

Answer:

This statement is unsupported by currently available information. The final document will state that gas has a value, but its market potential is so far down the road that it goes beyond the time scope of the present Teshekpuk Lake Special Area Study.

E.

Comment:

It is likely that an access road would be constructed adjacent to pipelines to connect the new facilities with the Trans-Alaska Pipeline. This is not mentioned in the report.

Answer:

A pipeline and accompanying road is discussed in this document as the most likely development.

F.

Comment:

Pipelines larger than the 18- to 30-inch range are possible.

Answer:

No pipeline size limitation is discussed in this document. It is assumed that pipeline size will be controlled by the desired through put capacity of the line.

G.

Comment:

Onshore facilities necessary to develop near-shore discoveries would be almost the same as those needed for onshore development.

Answer:

This statement is in agreement with this final document.

H.

Comment:

Economic considerations should be included in the decision making process for locating facilities.

Answer:

This final document does contain data to support the fact that radically uneconomic pipeline routes will have a significant impact on oil production from the Beaufort Sea, north and west of Teshekpuk Lake.

APPENDIX I

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Werner, Michael R., 1985, West Sak and Ugnu Sands: low gravity oil zones of the Kuparuk River area, North Slope, Alaska, abs., in AAPG Pacific section program with abstracts, p. 54.

APPENDIX II

COMMENTS RECEIVED ON THE DRAFT MINERAL EVALUATION

STATE OF ALASKA

OFFICE OF THE GOVERNOR

OFFICE OF MANAGEMENT AND BUDGET
DIVISION OF GOVERNMENTAL COORDINATION

BILL SHEFFIELD, GOVERNOR

CENTRAL OFFICE
POUCH AW
JUNEAU, ALASKA 99811-0165
PHONE: (907) 465-3562

SOUTHEAST REGIONAL OFFICE
431 NORTH FRANKLIN
POUCH AW, SUITE 101
JUNEAU, ALASKA 99811-0165
PHONE: (907) 465-3562

SOUTHCENTRAL REGIONAL OFFICE
2600 DENALI STREET
SUITE 700
ANCHORAGE, ALASKA 99503-2798
PHONE: (907) 274-1581

NORTHERN REGIONAL OFFICE
675 SEVENTH AVENUE
STATION H
FAIRBANKS, ALASKA 99701-4596
PHONE: (907) 456-3084

July 5, 1985

Mr. Mike Menge
Bureau of Land Management
4700 East 72nd Avenue
Anchorage, AK 99507

Dear Mr. Menge:

The State of Alaska appreciates the opportunity to review and comment on the Preview and Status Report on the Mineral Evaluation for the Teshekpuk Lake Special Area Study.

We have appreciated the effort and cooperation by the Bureau of Land Management in your development of the Mineral Evaluation. We look forward to this continued cooperative effort and discussions in the coming months as you evaluate the hydrocarbon potential for the area of study and begin to formulate land management policies for the area.

Since the mineral evaluation portion of the Teshekpuk Lake Special Area Study is still in progress, we do not have many comments to offer on the evaluation at this time. In addition to our few page-specific comments, provided as Enclosure 1 to this letter, we also recommend that all comments submitted on the Draft Mineral Evaluation be included as appendix to the final document. This would provide Phase 2 and Phase 3 decision-makers with easy access to all information and comments submitted during development of the Teshekpuk Lake Special Area evaluation reports.

We appreciate your efforts and consideration of our comments.

Sincerely,

Robert L. Grogan
Associate Director

Enclosure

cc: Michael Penfold, BLM, Anchorage
Robert Gilmore, USFWS, Anchorage
Jim Silva, BLM, Fairbanks
Bruce Baker, DFG, Juneau
Jim Eason, DNR, Anchorage

01-A35LH

ENCLOSURE 1

COMMENTS ON THE TESHEKPUK LAKE SPECIAL AREA STUDY
MINERAL EVALUATION STATUS REPORT

(Enclosure to Robert Grogan's July 2, 1985 response to Mike Menge regarding the Draft Mineral Evaluation Status Report of the Teshekpuk Lake Special Area Study)

Page 5: State geologists disagree with the general offshore production scenario presented on page 5. Specifically, they disagree with the statement that "The further offshore an oil discovery is made the lower the requirements for onshore support facilities." Instead, the further offshore a discovery is made, the greater the need may be for onshore support, particularly in such remote areas as the Teshekpuk Lake area. The "reasoning" that operations need to be more independent as the distance from a secondary support base increases is not sound reasoning because it cannot be assumed that permanent facilities can or will be constructed offshore. A pipeline or a commercial offshore discovery probably would not and could not practically be expected to be built offshore and make its first landfall near the Kuparuk or Prudhoe Bay oil fields. Geologists believe that such factors as subsea permafrost, offshore ice forces, maintenance requirements, and the greater potential for an under-ice or subsea oilspill make a subsea pipeline parallel to the coastline extremely impractical.

ab85062801rsc

NORTH SLOPE BOROUGH

OFFICE OF THE MAYOR

P.O. Box 69
Barrow, Alaska 99723

Phone: 907-852-2611

George N. Ahmaogak, Sr., Mayor

July 19, 1985

Mr. Mike Menge
Lead Mineral Evaluation
Bureau of Land Management
Anchorage District Office
4700 E. 72nd Avenue
Anchorage, Alaska 99507

Subject: Draft Habitat Evaluation Plan

Dear Mr. Menge:

The North Slope Borough has looked into the Draft Habitat Evaluation Plan and have no comment at this time. Since the staff of the Environmental & Conservation Office of the North Slope Borough helped in the collection of data and participated in the public hearings, we feel that the study is complete and will help us in making decisions concerning the Teshekpuk Lake Area.

I am looking forward to the meetings to be held in October at Anchorage to discuss the results from the Draft Report. If you have any questions or changes in dates, please contact Sandra McConkey at our Anchorage Liaison Office. Their phone number is (907) 561-5144.

Thank you for your cooperation in the Teshekpuk Lake Study and we hope to work with you in future projects that may affect the North Slope Borough.

Sincerely,

George N. Ahmaogak, Sr.

George N. Ahmaogak, Sr.
Mayor

Alaska Oil and Gas Association

AOGA

505 W. Northern Lights Boulevard
Suite 219
Anchorage, Alaska 99503
(907) 272-1481

June 3, 1985

Mr. Mike Menge
Bureau of Land Management
4700 E. 72nd Avenue
Anchorage, Alaska 99507

Teshekpuk Lake Special Area Study -- Mineral Evaluation

Dear Mr. Menge:

The Alaska Oil and Gas Association (AOGA) is a trade association whose member companies account for the majority of oil and gas exploration, production and transportation activity in Alaska.

The Association's comments on the subject evaluation are attached.

We appreciate the opportunity to comment.

Very truly yours,

WILLIAM W. HOPKINS
Executive Director

WWH:tp7:727

Attachment

ALASKA OIL AND GAS ASSOCIATION
COMMENTS ON
TESHEKPUK LAKE SPECIAL AREA STUDY
MINERAL EVALUATION

The following comments are made regarding Section III., Potential Onshore Facilities to Support Potential Offshore Oil and Gas Development, of the subject draft report.

B. Exploration Support Facilities and Logistics

The study considers the possibility of exploration support facilities located at Camp Lonely near Pitt Point. This is a very likely occurance given some exploration encouragement in the Western Beaufort Sea. The possibility of additional permanent facilities being constructed for exploration support should not be ruled out.

C. Onshore Facilities Required for Offshore Development and Oil Production

This section's statement regarding natural gas production should be reworded to indicate that natural gas production from the North Slope is likely in the future and should not be discounted for planning purposes.

1. Nearshore Production

d. Roads Connecting All Facilities

No mention is made of the probability of an access road connecting new facilities with operations at Kuparuk and Prudhoe Bay. It is likely that an access road would be constructed adjacent to pipelines connecting the new facilities with TAPS.

g. Pipeline and Associated Roads

Pipelines larger than the 18 to 30 inch range mentioned are possible. Again, the service road mentioned in this section could actually be an access road.

The facilities discussed in Section 1., a. thru i., are supposedly listed in order of likelihood of occurance, a. being most likely and i. being least likely. This statement could mislead some individuals to believe that these facilities are independent events when most of them are very likely if oil is found nearshore.

The possibility of an onshore pipeline is indicated as being low. If commercial quantities of oil are found in the Western Beaufort or NPR-A, the construction of an oil pipeline through the study

area will be the most desirable route to TAPS. These facts have been totally disregarded by this study. Consideration of preserving these options is strongly encouraged.

The last paragraph of Section 1 should include consideration of economics and technical feasibility as a parameter in the decision making process for locating facilities.

2. Offshore Production

This section starts with the premise that the further offshore a reservoir is the lower the requirements for onshore support facilities. This reasoning may not be correct. Some onshore support requirements will increase the further offshore the operations are. The exploration operations in the Navarin Basin require more onshore support facilities than nearshore operations because of the need for a staging area.

By the same reasoning as used above, pipelines in the study area were deemed less likely for operations further offshore. It may be that the distance offshore will have no bearing on the decision to bring pipelines to shore within the study area. Economics and a feasibility plan are a part in the total determination of an optimum oil transportation route.

This section concludes with a ranking of possible onshore facilities for offshore production in order of probability. The previous comment regarding this type of ranking applies here as well.

Figure II-1 shows two assumed trunkline routes: an offshore route along the three mile state/federal boundary, an onshore route south of the study area boundary and an onshore route south of the study area tying into TAPS at Pump Station 3. These routes will significantly impact the economics and feasibility of hydrocarbon development in the Western Beaufort Sea and NPR-A. Again, it is strongly recommended that the flexibility to utilize the most feasible pipeline routes be maintained.

TP7:727

ARCO Alaska, Inc.
ARCO Exploration - Alaska Operations
Post Office Box 100360
Anchorage, Alaska 99510-0360
Telephone 907 276-1215

MAY 31 2 59 PM
BUR...
ANC...
MGMT.
ST. OFC.

May 31, 1985

Mr. Mike Menge
Bureau of Land Management
4700 E. 72nd Avenue
Anchorage, AK 99507

Dear Mr. Menge:

Teshekpuk Lake Special Area Study
Mineral Evaluation - Draft

ARCO Alaska, Inc., appreciates the opportunity to comment on the subject study. After reviewing the Mineral Evaluation, we wish to make the following observations and comments regarding Section III., Potential Onshore Facilities to Support Potential Offshore Oil and Gas Development of the subject draft report.

B. Exploration Support Facilities and Logistics

The study concludes the possibility of exploration support facilities located at Camp Lonely near Pitt Point. This is a very likely occurrence given some exploration encouragement in the Western Beaufort Sea. The possibility of additional permanent facilities being constructed for exploration support should not be ruled out.

C. Onshore Facilities Required for Offshore Development and Oil Production

The statement in this section regarding natural gas production should be reworded to indicate that natural gas production from the North Slope is likely in the future and should not be discounted for planning purposes.

1. Nearshore Production

d. Roads Connecting All Facilities

No mention is made of the probability of an access road connecting new facilities with operations at Kuparuk and Prudhoe Bay. It is likely that an access road would be constructed adjacent to pipelines connecting the new facilities with TAPS.

ARCO Alaska, Inc. is a Subsidiary of AtlanticRichfieldCompany

MAY 31 2 59 PM

g. Pipeline and Associated Roads

Pipelines larger than the 18- to 30-inch range mentioned are possible. Again, the service road mentioned in this section could actually be an access road.

The facilities discussed in Section 1., a. through i., are supposedly listed in order of likelihood of occurrence, a. being most likely and i. being least likely. This statement could mislead some individuals to believe that these facilities are independent events when most of them are very likely if oil is found nearshore.

The possibility of an onshore pipeline is indicated as being low. If commercial quantities of oil are found in the Western Beaufort or NPR-A, the construction of an oil pipeline through the study area will be the most desirable route to TAPS. These facts have been totally disregarded by this study. Consideration of preserving these options is strongly encouraged.

The last paragraph of Section 1 should include consideration of economics as a parameter in the decision-making process for locating facilities.

2. Offshore Production

This section starts with the premise that the further offshore a reservoir is the lower the requirements for onshore support facilities. This reasoning may not be correct. Some onshore support requirements will increase the further offshore the operations are. The exploration operations in the Navarin Basin require more onshore support facilities than nearshore operations because of the need for a staging area.

By the same reasoning above, pipelines in the study area were deemed less likely for operations further offshore. It may be that the distance offshore will have no bearing on the decision to bring pipelines to shore within the study area. Economics and feasibility play a part in determining the optimum oil transportation route.

This section concludes with a ranking of possible onshore facilities for offshore production in order of probability. The previous comment regarding this type of ranking applies here as well.

MAY 31 2 55 PM '85

Figure II-1 shows two assumed trunkline routes: an offshore route along the three-mile state/federal boundary and an onshore route south of the study area tying into TAPS at Pump Station 3. These routes will negatively impact the economics and feasibility of hydrocarbon development in the Western Beaufort Sea and NPR-A. Again it is strongly recommended that the ability to utilize the most feasible pipeline routes be maintained.

As stated in our letter of February 22, 1985, ARCO Alaska, Inc., believes that our industry can coexist, with minimal impact, with the culture and inhabitants indigenous to the Teshekpuk Lake area, as evidenced in the Prudhoe Bay and Kuparuk areas. We appreciate the opportunity to comment on this important area.

Very truly yours,

John B. Kavanagh

John B. Kavanagh
Land Manager

EXXON COMPANY, U.S.A.
POUCH 6601 • ANCHORAGE, ALASKA 99502 (907) 276-4552

ALASKA OPERATIONS
WESTERN DIVISION

RICHARD H. WEAVER
OPERATIONS MANAGER

June 3, 1985

RE: Teshekpuk Lake Special Area
Study - Mineral Evaluation

Mr. Mike Menge
Bureau of Land Management
PO Box 1150
Fairbanks, Alaska 99707

Dear Mr. Menge:

Exxon is pleased to provide comments on the Mineral Evaluation (ME) of the Teshekpuk Lake Special Area Study. We understand that the ME is still in preliminary form and we will have another opportunity to comment on it. At this time, we are restricting our comments to our major area of concern. We look forward to the opportunity for review of the completed draft at a later date.

Our concern lies with the following two statements made on Page 5 of proposed Chapter III, both of which indicate a low likelihood of an onshore pipeline through the Teshekpuk Lake Special Area from nearby offshore leases:

> "The likelihood of an onshore oil pipeline is low, but it is possible and must be considered."
>
> "For these same reasons, a pipeline from these offshore sites would probably follow an offshore route and not make a landfall until near Kuparuk or Prudhoe Bay oil fields, out of the [Teshekpuk Lake Special Study Area]".

It is premature to conclude that a pipeline from an offshore development would be more likely to follow an offshore route than to come directly onshore. Economic, technical feasibility and/or environmental considerations will dictate the preferred route, and may exclude an offshore alternative altogether. By a combination of these statements in the Mineral Evaluation and a proposed closure of all coastal areas to pipelines in the Habitat Evaluation, the Bureau of Land Management may unreasonably be jeopardizing the potential for offshore oil and gas development in the vicinity of Cape Halkett.

A DIVISION OF EXXON CORPORATION

We request that these incorrect and premature statements be deleted from the ME.

We appreciate the opportunity to comment on this important study and will be pleased to comment on the Mineral Evaluation more fully when the final draft is issued.

Very truly yours,

R. H. Weaver

RHW:kyn/439

Texaco Inc
550 West Seventh Avenue
Suite 1320
Anchorage AK 99501
907 278-9611

May 30, 1985

TESHEKPUK LAKE SPECIAL
AREA STUDY
MINERAL EVALUATION

Mr. Michael Menge, Chief
Branch of Resource Evaluation
Anchorage District Office
4700 East 72nd Avenue
Anchorage, AK 99507

Dear Mr. Menge:

We at Texaco appreciate the chance to comment on the Mineral Evaluation of the Teshekpuk Lake Special Area, especially since we own leases within and adjacent to TLSA which were granted by BLM.

The pipeline routes from offshore development described in this document seem somewhat unrealistic. Under C.2., page 5, the assumption is made that a pipeline "would probably follow an offshore route and not make a landfall until near Kuparuk or Prudhoe Bay oil fields. . . ." We would suggest that this is a leap in pipeline technology, in that no submarine pipelines have yet been laid in the Beaufort Sea. We believe a more likely scenario would have a pipeline routed directly to shore, and would continue easterly from that point, on shore, to connect with the pipeline at Kuparuk or Prudhoe Bay. The preferred route from a discovery either offshore or onshore west of the TLSA would almost certainly be via the coastal portion of TLSA.

Thank you again for the opportunity to comment.

Very truly yours,

Don Hartman

D. C. HARTMAN
Advanced Exploration Land Representative

DCH:bjs

D2/45

APPENDIX III

AUTHORS INVOLVED IN THE DEVELOPMENT OF THIS MINERAL EVALUATION

I. AUTHORS

Chapter 1 - by Mike Menge

Chapter 2 -

Geology - Ron Teseneer
Geophysics - Dave Evans
Engineering - Aden Seidlitz
Economics - Mike Menge, with data supplied by John Young

Chapter 3 - by Mike Menge, with data supplied by John Young and Bill Hauser

Chapter 4 - by John Catlin and Joe Dygas

APPENDIX IV

The prospect analysis summary sheet is used to consolidate all the geologic, geophysical and engineering information gathered on a prospect. Below is a brief description of the subheadings listed on the following example of the summary sheet.

Volumetric Input Parameters - These variables, which describe the parameters of the reservoir rock, are used to estimate the volume of a potential reservoir.

Reservoir Physical Conditions, Fluid Characteristics - These variables are used to formulate drilling and development plans for producing the reservoir, should it contain hydrocarbons.

Derived Parameters - Available information may indicate the reservoir is not filled to capacity. The production areas, estimated by the available information, is the size of the reservoir believed to contain hydrocarbons. The formation volume factor and gas/oil ratio (GOR) are used to relate fluid characteristics on the surface to those at total depth.

Resources-In-Place - Estimated amount of hydrocarbons contained in the reservoir rock.

Recovery Efficiency - Due to the characteristics of the reservoir rock, only a portion of the resources-in-place can be produced. Recovery efficiency is an estimate of the percentage of the resources-in-place which can be produced.

Recoverable Resources - Estimated amount of hydrocarbons produced during the life of the field (Resources-In-Place x Recovery Efficiency).

Geologic Risk - Whether a prospect is hydrocarbon-bearing or dry cannot be determined until it has actually been drilled. Geologic risk is an assessment of the probability that the prospect will contain hydrocarbons.

Engineering Summary - Describes the surface facilities needed to produce the recoverable resources and subsequent acreage disturbed.

Conclusion - A brief discussion of the positive and negative aspects of whether the prospect will be hydrocarbon-bearing.

PROSPECT SUMMARY (GEOLOGY - GEOPHYSICS - ENGINEERING)

Prospect Number _____ Refer to Plate(s) _____

Formation:

Volumetric Input Parameters:

Size of Closure	_____	acres
Trap fill	_____	%
Reservoir pay thickness	_____	ft. (average)
Reservoir rock porosity	_____	% (average)
Water saturation	_____	%
Permeability	_____	md

Reservoir Physical Conditions, Fluid Characteristics

Depth	_____	ft.
Temperature	_____	degrees F
Pressure	_____	psi
API gravity	_____	degrees
Oil viscosity	_____	cp

Derived Parameter:

Production area	_____	acres
Formation volume factor	_____	bbl/STB
GOR	_____	SCF/bbl

Resources In-Place:

Recovery Efficiency:

Recoverable Resources:

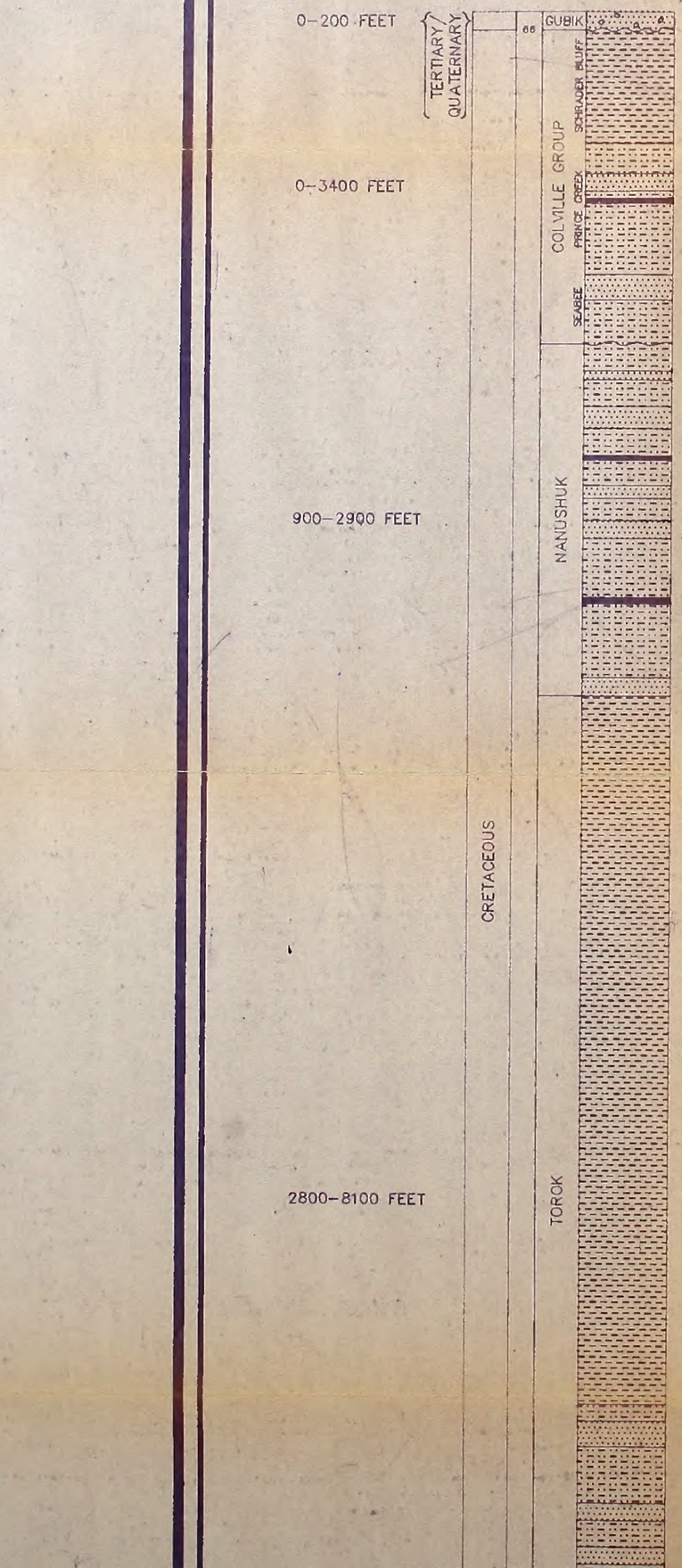
Geologic Risk:

Engineering Summary:

Drainage radius/well spacing	_____
Number of pads	_____
Number of wells	_____
Number of CPFs	_____
Miles of road	_____
Sand/gravel requirements	_____
Acres disturbed	_____
Acres affected	_____
Pipeline distance	_____

Conclusion:

TESHEKPUK LAKE SPECIAL AREA
GENERALIZED STRATIGRAPHIC COLUMN



0–200 FEET

SILT, SAND, AND GRAVEL, UNCONSOLIDATED, ICE COMMON

0–3400 FEET

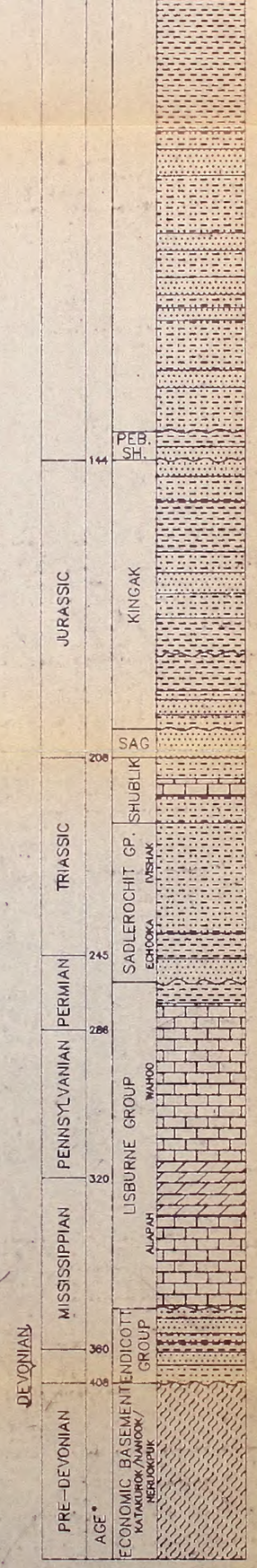
CLAYSTONE TO SANDSTONE, TAN TO GRAY, LOCALLY PYRITIC, COAL, LIGNITIC TO SUBBITUMINOUS

900–2900 FEET

SHALE TO SANDSTONE, TAN TO GRAY, FOSSILIFEROUS, LOCALLY PYRITIC, LOCALLY ABUNDANT COAL

2800–8100 FEET

SHALE WITH SILTSTONE AND SANDSTONE, GRAY TO BROWN, SOME FLOATING SAND GRAINS, LOCALLY PYRITIC, LOCALLY CALCAREOUS



0–300 FEET	PEB. SH.	SHALE, DARK GRAY TO BLACK, LOCALLY PHOSPHATIC, SOME FLOATING SAND GRAINS; SANDSTONE, LIGHT GRAY
0–2900 FEET	KINGAK	SHALE WITH MINOR SANDSTONE AND SILTSTONE, GRAY TO BROWN, GLAUCONITIC, PYRITIC, LOCALLY FOSSILIFEROUS, SOME FLOATING SAND GRAINS
0–300 FEET	SAG	SANDSTONE,GRAY, FINE GRAINED, POORLY SORTED, SLIGHTLY CALCAREOUS, PYRITIC
100–600 FEET	SHUBLIK	SANDSTONE TO SHALE, LIGHT GRAY TO BLACK, SILICEOUS TO CALCAREOUS, PYRITIC, FISSILE, SLIGHTLY GLAUCONITIC; LIMESTONE, TAN, FOSSILIFEROUS, PHOSPHATIC
100–1600 FEET	SADLEROCHIT GP. IVISHAK / ECHOOKA	SANDSTONE AND SILTSTONE WITH MINOR SHALE, WHITE TO RED, ARGILLACEOUS, SILICEOUS TO CALCAREOUS
0–3900 FEET	LISBURNE GROUP WAHOO / ALAPAH	LIMESTONE AND DOLOMITE WITH MINOR SILTSTONE AND SHALE, WHITE TO DARK BROWN, FOSSILIFEROUS, LOCALLY LITHOGRAPHIC OR CHALKY, CHERTY
0–800 FEET	ENDICOTT GROUP	SILTSTONE AND SANDSTONE WITH MINOR SHALE, LIGHT GRAY TO PREDOMINATELY RED, CALCAREOUS TO SILICEOUS, CHERTY, SANDS ARE ARGILLACEOUS
	ECONOMIC BASEMENT KATAKUROK/ANNOOK/ NERUOKPUK	"ARGILLITE" – GRAY TO BLACK, HARD, SLATY, QUARTZ AND CALCITE FILLED PARTINGS – METASEDIMENTS

* AGE EXPRESSED IN MILLIONS OF YEARS BEFORE PRESENT

Plate 1.

BEACH DEPOSITS
(GRAVELLY SAND)

BEACH DEPOSITS
(GRAVELLY SAND)

EOLIAN

ALLUVIUM

EOLIAN
SAND

SAND

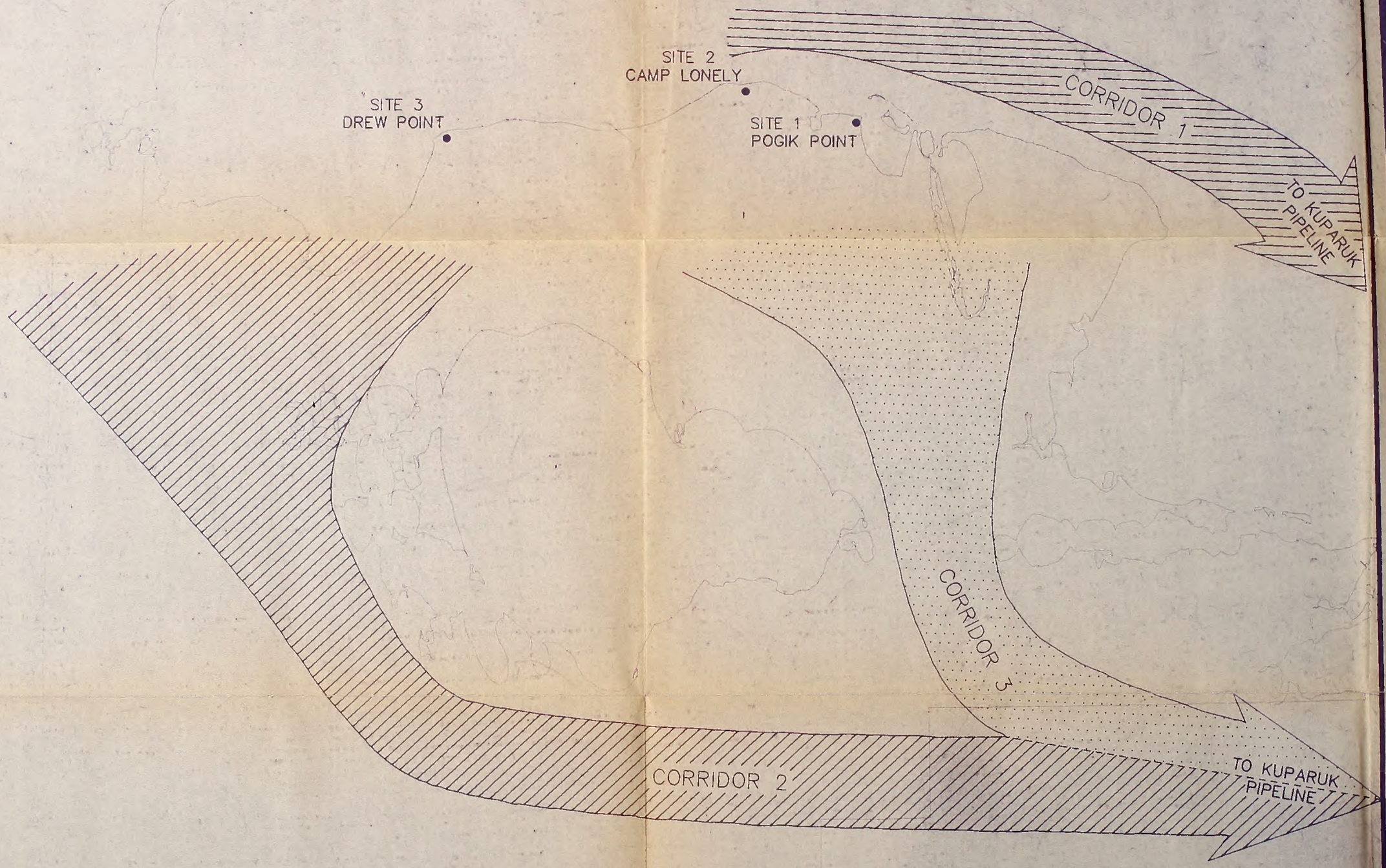
TESHEKPUK LAKE SPECIAL
AREA STUDY

Plate 2.

SAND AND GRAVEL
RESOURCES

N

0 5 10
MILES



TESHEKPUK LAKE SPECIAL
AREA STUDY

Plate 3.

PIPELINE CORRIDORS
AND POTENTIAL
PIPELINE LANDING SITES

N

0 5 10
MILES

TESHEKPUK LAKE SPECIAL AREA STUDY

Plate 4.

LAND LEASE STATUS

FEDERAL LEASES

STATE LEASES

NATIVE LEASES

N

0 10 20

Miles

Barrow

Meade River

Beaufort Sea

TLSA

NATIONAL PETROLEUM RESERVE

Ikpikpuk River

Colville River

Deadhorse/ Prudhoe Bay

CENTRAL ARCTIC REGION

Sagavanirktok River

Canning River

ARCTIC NATIONAL WILDLIFE REFUGE

TESHEKPUK LAKE SPECIAL AREA STUDY

Plate 5.

REGIONAL PRODUCTION ACTIVITY

OIL & GAS FIELDS

RECENT WELLS

OIL PIPELINE

N

0 10 20
Miles

Beaufort Sea

BARROW FIELD

Barrow

SIMPSON FIELDS

ANTARES

Meade River

MUKLUK

COLVILLE DELTA

MILNE POINT

SEAL ISLAND

GWYDYR BAY

SAG DELTA

KUPARUK FIELD

PRUDHOE BAY FIELD

Kuparuk Pipeline

Deadhorse Prudhoe Bay

Trans-Alaska Pipeline (TAPS) & Haul Road

Pt. THOMPSON

FLAXMAN IS.

NATIONAL

PETROLEUM

RESERVE

TLSA

Ikpikpuk River

Colville River

CENTRAL

ARCTIC

Sagavanirktok River

Canning River

KAVIK FIELD

KEMIK FIELD

ARCTIC NATIONAL WILDLIFE REFUGE

WOLF CREEK FIELD

UMIAT FIELD

GUBIK FIELD

E. UMIAT FIELD

REGION